Supporting Information

Directly Coating Multifunctional Interlayer on the Cathode via Electrospinning for Advanced Lithium Sulfur Batteries

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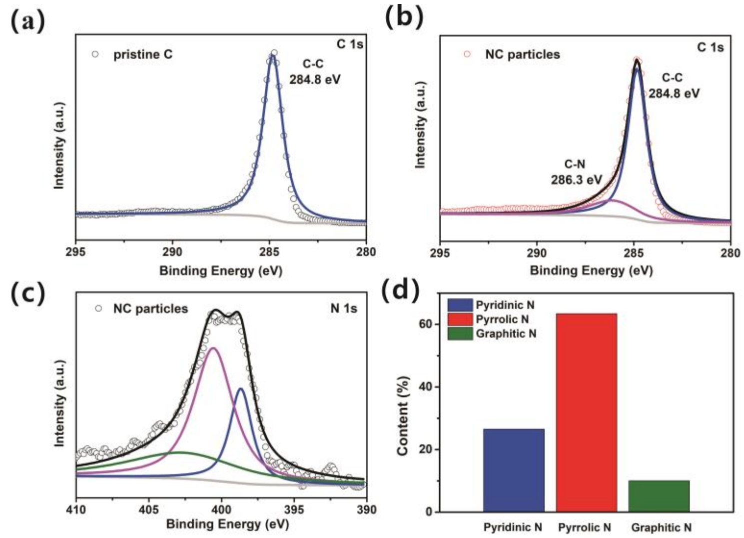

Figure S1. (a) C 1s spectra of pristine C, (b) C1s spectra of NC particles, (c) N 1s XPS spectrum of NC particles, (d) corresponding N content.

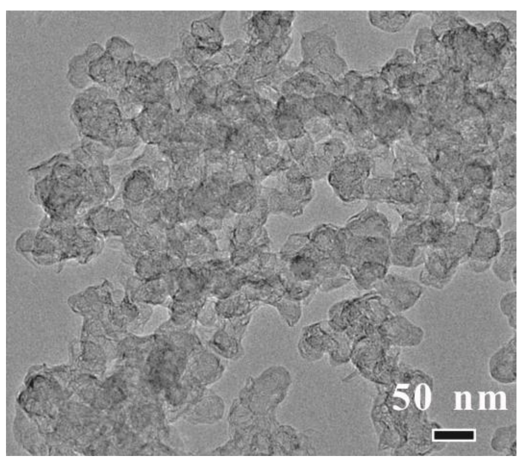

Figure S2. TEM image of NC particles.

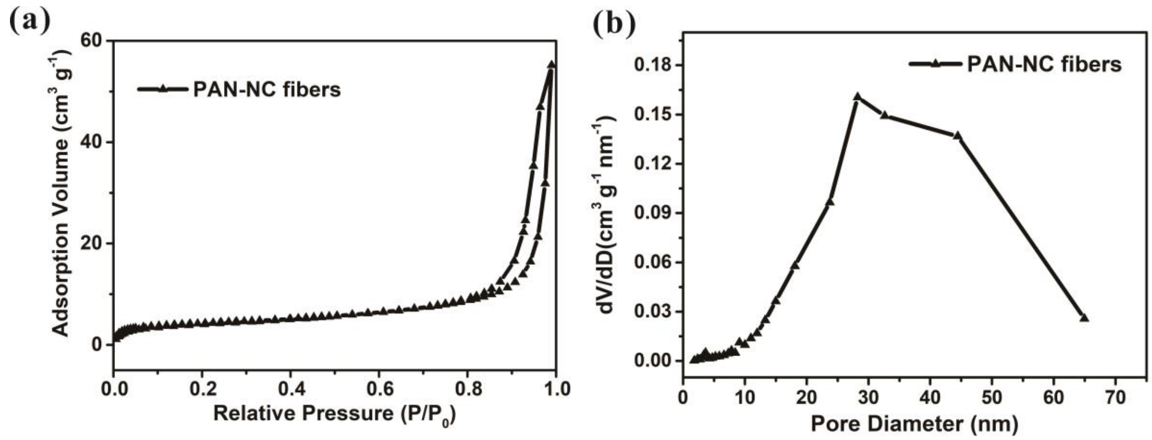

Figure S3. (a) nitrogen adsorption-desorption isotherm of PAN-NC fibers, (b) corresponding pore size distribution.

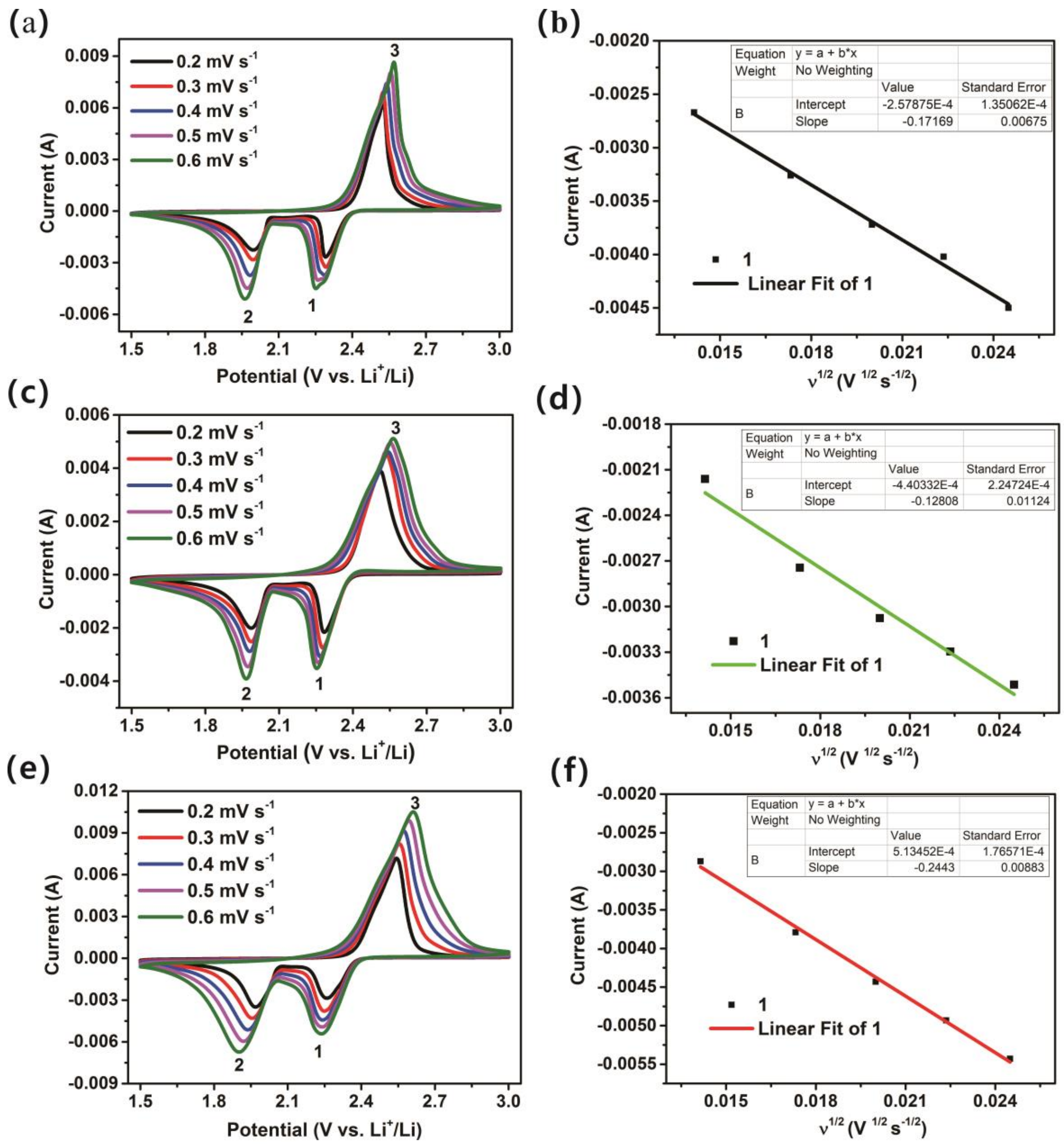

Figure S4. CV curves at different scanning rates and corresponding i_{pa} - $\nu^{1/2}$ scatters and linear fitting of (a, b) sulfur cathode, (c, d) PAN@cathode, (e, f) PAN-N@Cathode.

The diffusion coefficient of Li^+ (D_{Li^+}) can be calculated from the following Randles-Sevcik equation: [1-2]

$$I_p = 0.4463\mathrm{nFAC}(\frac{nFvD}{RT})^{1/2} \qquad (1)$$

Where I_p is the peak current (A), n is the number of electrons transferred, F is the Faraday's constant (96485 C mol^{-1}), A is electrode area (1.14 cm^2), C represents concentration of Li^+ (mol cm^3), R is gas constant (8.314 J K^{-1} mol^{-1}), T is temperature (K), D is Li^+ diffusion coefficient (cm^2 s^{-1}), ν is scan rate (V s^{-1}). Based on the equation 1, the value of D can be obtained from the slope of $dI/d\nu^{1/2}$. Peak 1 in CV plots is chosen for calculation.

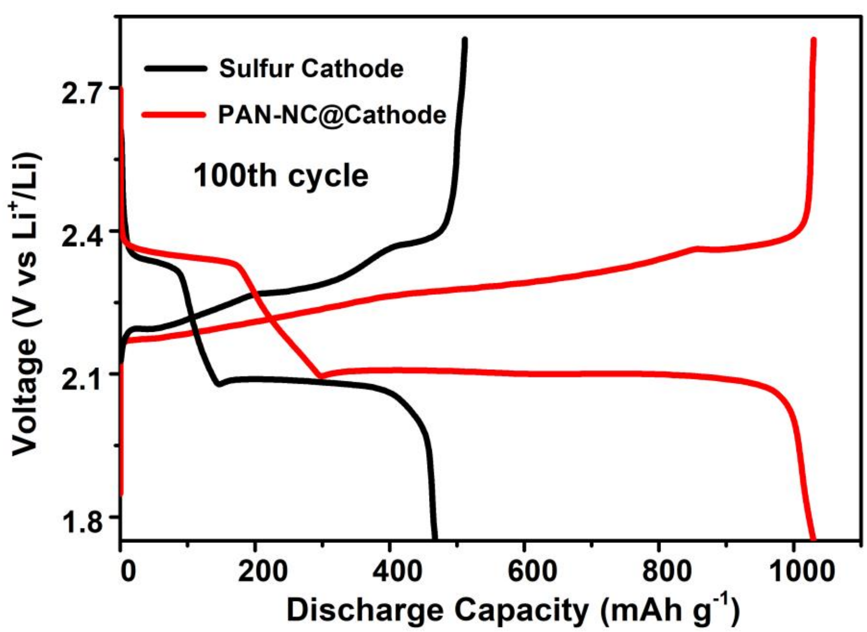

Figure S5. Discharge and charge plots of sulfur cathode and PAN-NC@Cathode at 200 mA g^{-1} after 100 cycles.

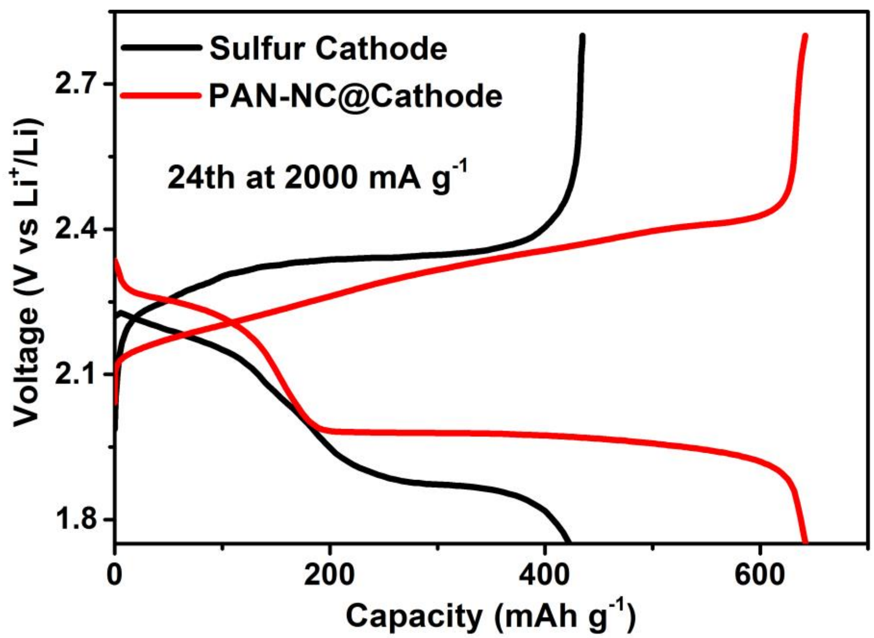

Figure S6. Discharge and charge plots of sulfur cathode and PAN-NC@Cathode at 2000 mA g^{-1} at the 24 cycle.

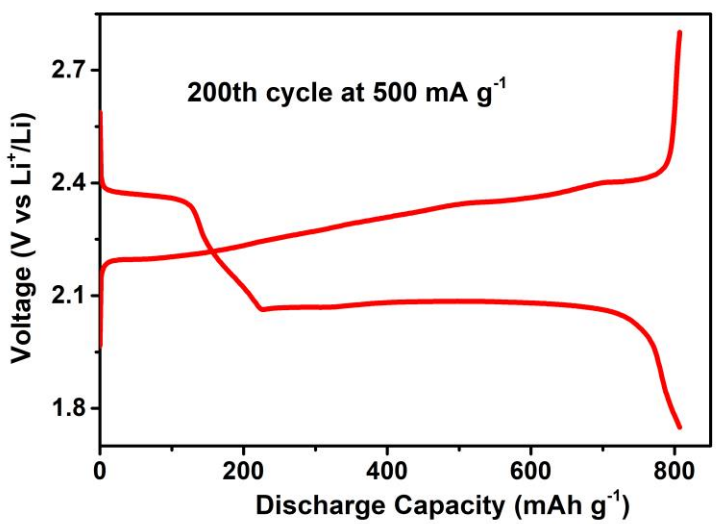

Figure S7. Discharge and charge plots of PAN-NC@Cathode at 500 mA g^{-1} after 200 cycling.

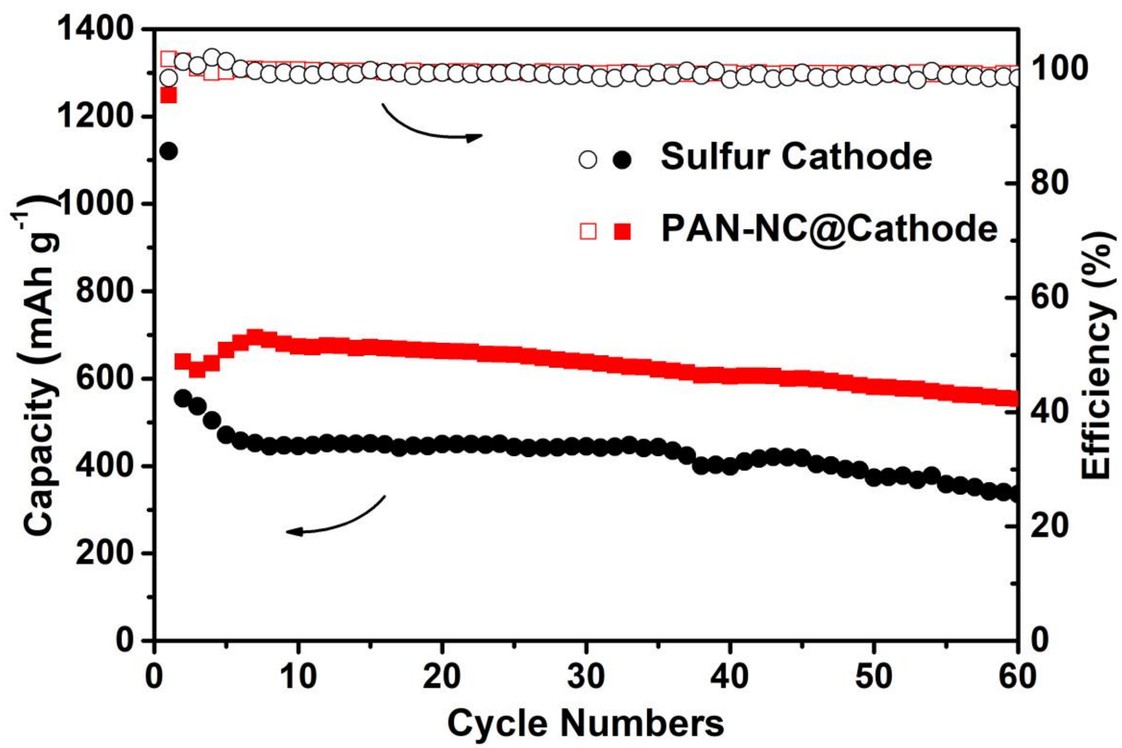

Figure S8. The cycling performances of sulfur cathode and PAN-NC@Cathode at 2000 mA g^{-1} after one cycle activation at 200 mA g^{-1}.

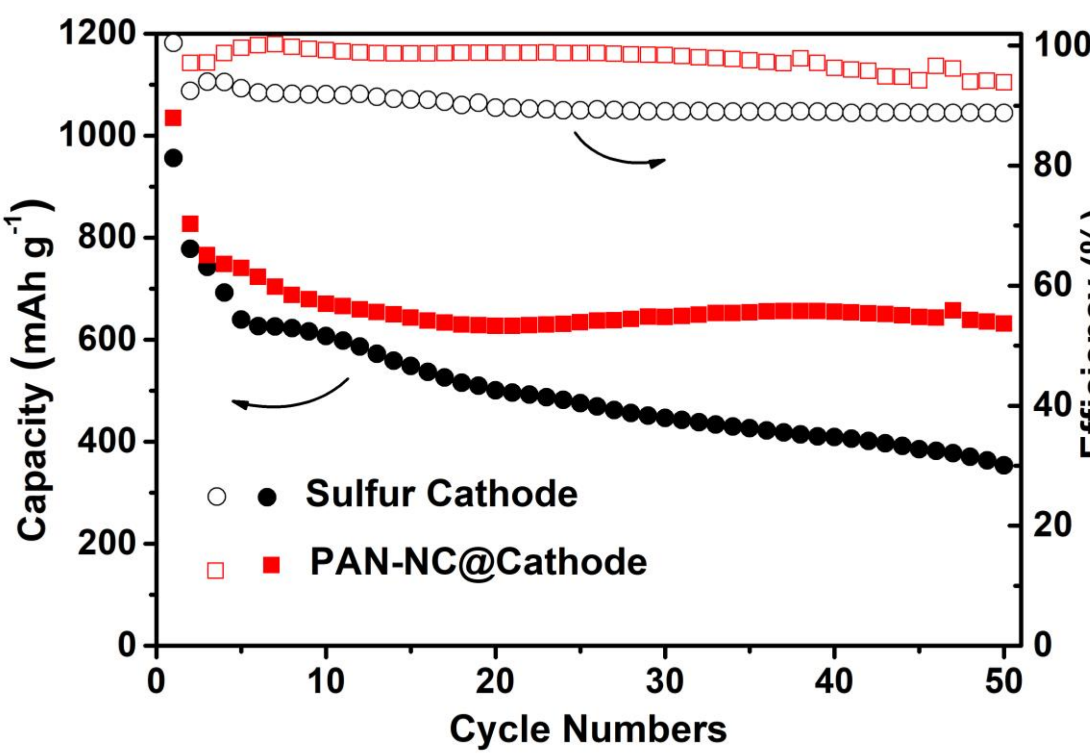

Figure S9. The cycling performances of sulfur cathode and PAN-NC@Cathode at 200 mA g^{-1} with higher sulfur loading of 4 mg cm^{-2}.

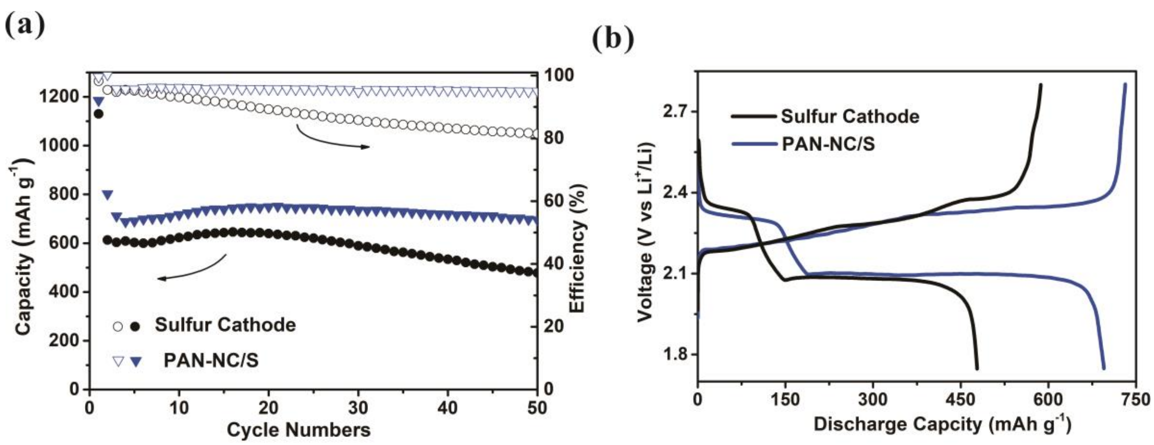

Figure S10. (a) the cycling performances of sulfur and PAN-NC/S cathodes at 500 mA g^{-1} after initial activation at 200 mA g^{-1}, (b) the discharge and charge curves of sulfur and PAN-NC/S cathodes at the 50th cycle.

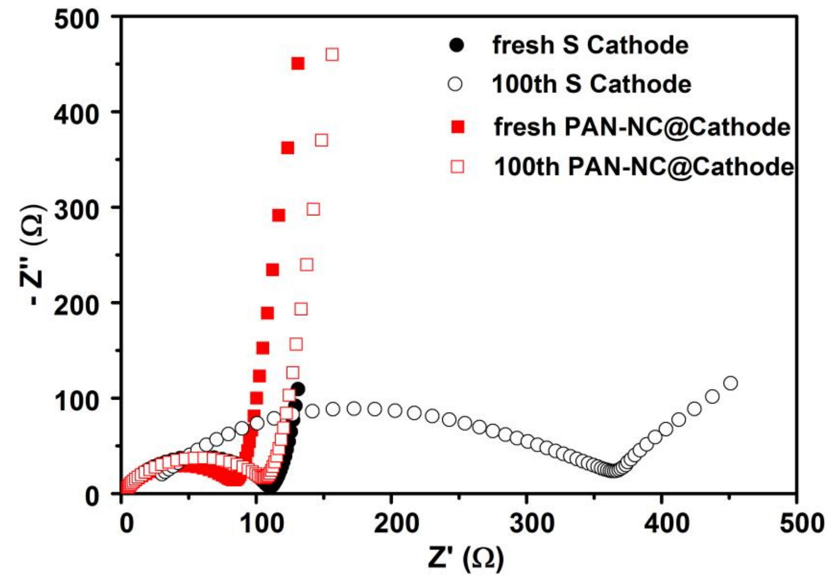

Figure S11. EIS spectra of cathodes before and after cycling

Table S1. The references[3-10] about adding interlayer in Li-S batteries.

	interlayer	method	Weight ($mg\ cm^{-2}$)	cathode	Current density ($mA\ g^{-1}$)	Capacity ($mAh\ g^{-1}$) after 100	Capacity retention
Inserting	[3]Microporous carbon paper (MCP)	1 mixing conductive carbon with binder at 3:2 mass ratio 2 roll-pressing	-	S	1675	1000	85.0%
	[4]Reduced graphene oxide with carbon black (rGO-CB)	1 suction-filtering rGO-CB suspensions 2 heat treatment	-	S	200	894	70.9%
	[5]tubular polypyrrole (T-PPy) film	1 self-degraded template method 2 vacuum filtration and drying	1	S/C	335	~964	68.9%
	[6]Cyclized-Polyacrylonitrile Modified CNF (CP@CNF)	1 electrospun CNF from PAN 2 dip-coated PAN, thermal treatment	-	S	502	910	85.1%
	[7]TiO_2 decorated CNF (CNF-T)	1 electrospun CNF from PAN 2 dip-coated TiO_2, thermal treatment	0.5–0.6	S	335	~840	63.2%
	[8]V_2O_5 -Decorated Carbon Nanofiber	1 electrospun CNF from PAN 2 solvothermal , thermal treatment	1	S	500	889	87.1%[b]
coating	[9]TiO_2 /Graphene	coating with the doctor blade	0.1	PCNTs–S	837	~1040 after 300	99%[a]
	[10]poly (3,4 ethylenedioxythiophene)-poly (styrene sulfonate)/Black Pearl (PS/BP)	electrospinning	0.09	NPCS-S	502	920	88.5%
This work	PAN-NC	electrospinning	0.14	S	200	1029	80.5%
					500	840	90.9%[b]

[a] with a gradual increase for the first 20 cycles, [b] after one cycle activation, the capacity retention is calculated based on the second capacity.

Table S2. The results of resistivity measurements.

materials	ρ Ω cm	σ s m^{-1}
PAN	14265	7.0 x 10^{-3}
Carbon black	0.1	1.0 x 10^{3}
PAN-NC	0.3	3.3 x 10^{2}

Electrical resistivity was measured with a four-contact method under the pressure of 4 MPa.

References

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